Impact of market design and public acceptance on the regional distribution of wind energy - simulation results for Germany

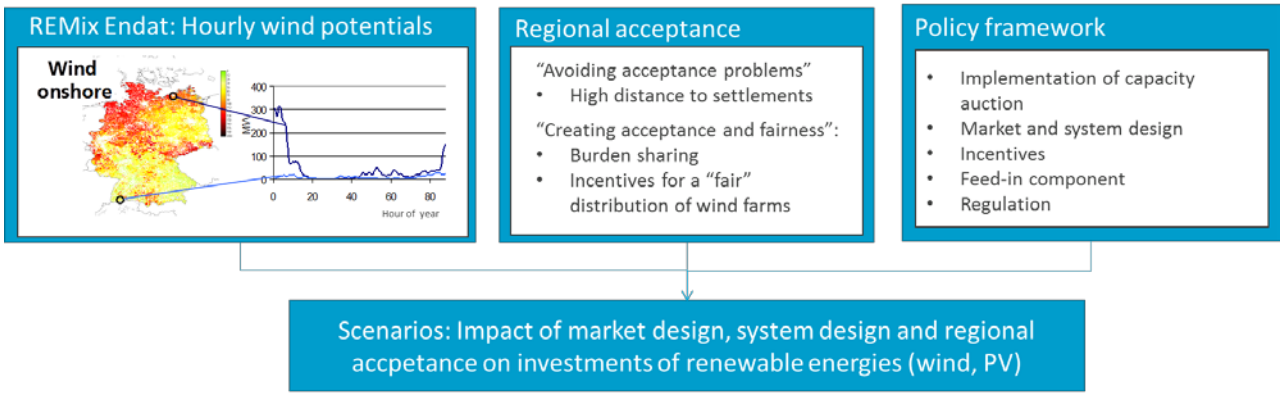
Frieder Borggrefe, DLR - German Aerospace Center, +49-711-6862, frieder.borggrefe@dlr.de

In Germany, in 2017 the support scheme for renewables changed to capacity auctions for wind power. While in theory auctions have a high degree of overall target fulfilment, the regional distribution of investments varies based on the implemented market designs. Results from 2017 show that changes in market design lead to a significant shift of investments in the south of Germany: While previously support schemes incentivised investments, in 2017 almost no wind projects were accepted.

This paper investigates the regional distribution of investments into wind energy, when different designs of capacity auctions are implemented. The modelling approach draws on a parallel analysis of technical potential, expected revenues and social acceptance to determine economic wind power investments. The European electricity model REMix is then used to simulate investments in wind energy in order to analyze: What measures and incentives on a German/European level could be beneficial to meet regional targets?

Overview

In recent years social acceptance of investment projects for renewables, power plants and power lines have gained significant attention by sociologists and policy makers. Results of previous studies show (Sonnberger 2017), that with regard to wind energy people tend to have a considerably high level of trust and acceptance of wind power projects in general. However, when wind power stations are planed close to settlements, the level of acceptance decreases sharply. Policy makers in Germany (in the state of North Rhine-Westphalia and Bavaria) therefore proposed to “avoid acceptance problems” by introducing a minimum distance of wind farms to settlements.



Graph 1: Scenario runs draw on an analysis of technical wind potential, social acceptance and policy design

The paper therefore aims to answer the following questions:

- How can public acceptance be integrated into the analysis of wind investments? Which measures and market incentives can increase public acceptance for additional investments into wind power?
- What incentives provide different remuneration schemes and auction design on the regional distribution of wind energy?
- What regulatory measures and incentives on a German and European level could be beneficial to reach the regional targets (e.g. the states targets)? (here: targets of the state of Baden-Wuerttemberg)

The analysis was conducted exemplarically for Germany and the state of Baden-Wuerttemberg.

Methods

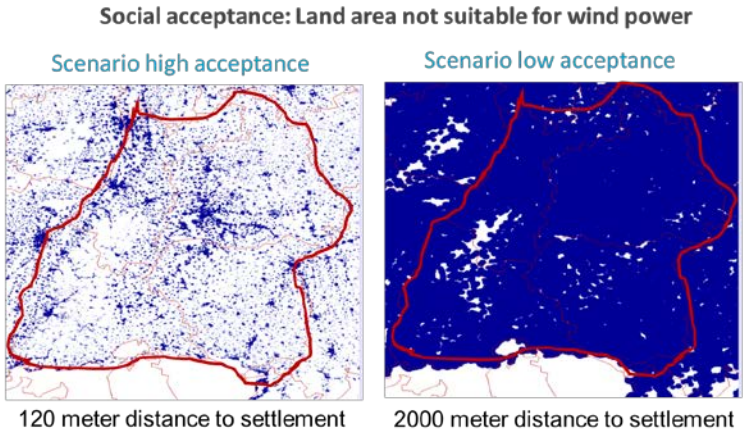
As shown in Graph 1, the selected modelling approach consists of three parts:

1. **Technical potential**: A geodata (GIS) based analysis has been used to investigate the technical potential of wind power in different regions in Germany. The model REMix-Endat uses a high resolution spatial analysis and determines potential areas within Germany, where investments into additional wind farms could talke place. The calculation is based on distance from settlements, infrastructure, type of landscape (landcover data), slope and altitude . In a second step the model determines, based on historic windspeeds, the estimated hourly feed-in of renewables in future years for these different locations.

2. **Market design and incentives:** In a second step, a modell analyzing the long term investment incentives from different political frameworks and market designs will be investigated for different regions and types of locations. The model determines the expected net present value for each location.

3. **Public acceptance:**
   Aspects of public acceptance will be integrated into the model. While general acceptance for wind is high, local acceptance must be accomplished to enable investments. Two path for increasing local acceptance are investigated: Avoiding acceptance problems in the first place and creating distributional fairness and trust. The effect of both measures on the energy system and long term investments are investigated.

Technical potential, market incentives and results from the acceptance analysis are integrated into the European energy system model REMix. Based on the estimated hourly dispatch and price estimates for representative years up to 2050, an overall potential can be determined for each location. The modell depicts investments – it especially adds wind (an PV) capacity to meet the renewable targets for Germany. A first analysis of market design and incentives for investments and detailed description can be found in Borggrefe (2018). This paper extends the model and focuses on the integration of aspects of "public acceptance".



Graph 2: Analysis of wind power potential in Baden-Wuerttemberg

Results

Creating acceptance by „avoiding acceptance problems" as it is proposed/implemented by some states in Germany will not provide sufficient areas for wind power onshore (Graph 2). Investments into other more expensive renewable technologies will increase costs of electricity procurement. A second set of scenarios analyses the impact of a "fair distribution" of wind capacity across all regions in Germany on market results, system stability and target fulfillment. In the coming decades this will lead to increasing costs for investment and remuneration. In the long run the resulting energy system also provides benefits, because cost extensive investments into grid can be saved.

References

Sonnberger, M., Ruddat, M. (2017): Local and socio-political acceptance of wind farms in Germany. In: Technology in Society, Volume 51, 2017, Pages 56-65

Borggrefe, F. (2018): "Market design and distribution effects, Impact of market design on the regional distribution of wind power stations" (in German) to be presented at the 15th Symposium on Energy Innvoation (EnInnov), February 2018 in Graz, Austria